Potential Uses of Smart Grid for Renewable Integration

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Summary

- Increased use of intermittent resources changes the need for resources
- Preliminary studies show significant ancillary service increases needed for wind integration
- PG&E has adopted a pragmatic approach to understand intermittent resource integration
- Demand response can help integrate intermittent resources; program design and technology need to evolve
- PG&E is investigating Smart Grid opportunities

Increased use of intermittent resources changes the need for resources

- Variability and uncertainty of intermittent resources increase need for regulation, load following, day-ahead commitment, ramping resources
- Resource need is currently set by reliability target (expected peak + planning reserve margin or PRM)
- PRM evaluation is based on loss of load estimation which does not account for forecast uncertainty or operating needs of load or intermittent resources
- Resources available to meet reliability requirements may not be adequate to satisfy operating requirements of additional intermittent resources
- Today's preferred resources do not help integrate intermittent resources

Preliminary studies show significant ancillary service increases needed for wind integration

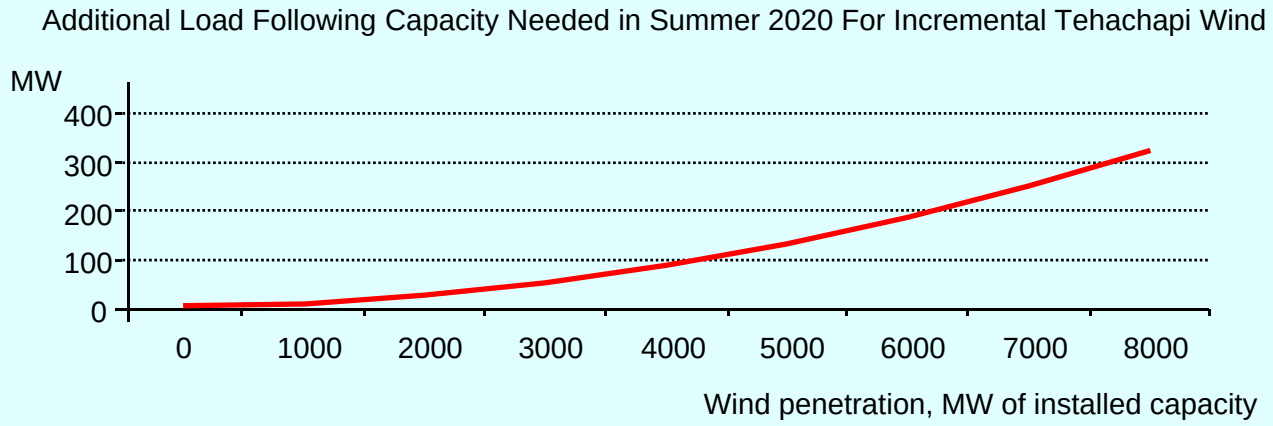
- CAISO's 20% RPS Nov. 2007 operating analysis found :
  - Regulation: 170-250 MW (Reg-Up); 100-500 MW (Reg-Down)
  - Supplemental energy stack (intra-hour load following): increase comparable with hour-ahead load forecast error (standard deviation is 600 MW to 900 MW)
  - Morning ramp increase by 926 MW to 1,529 MW; evening ramp by 427 MW to 984 MW, depending on the season
- On-going CAISO's integration study is re-evaluating the 20% RPS integration needs
- CAISO will study integration requirements for 33% RPS target this year; findings will inform need determination in CPUC's long-term procurement plan proceeding

PG&E has adopted a pragmatic approach to understand intermittent resource integration

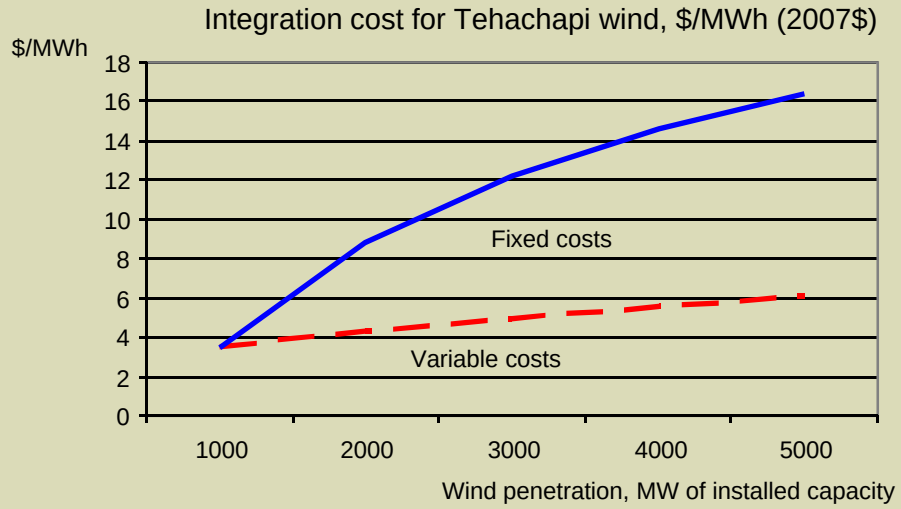
- PG&E developed a tool (Integration Calculator) to understand the requirements and cost of integrating intermittent resources
- Evaluate operating requirements of different intermittent resource portfolios (regulation, load following, day-ahead commitment)
- Estimate fixed and variable integration cost
- Multiple intermittent portfolios in CAISO's or individual LSE's area
- Flexible, dynamic tool with inputs tailored to portfolio mix and service area being studied
  - Intermittent resource amounts
  - Hourly load and generation profiles
  - Standard deviation of forecast uncertainty for both load and intermittent generation for day-ahead, hour-ahead and real-time dispatch timeframes
  - Correlation among uncertainties
  - Fixed and variable costs of integration resources

Integration Calculator's sample output

Additional load following capacity needed to integrate Tehachapi wind in the CAISO control area



Variable and fixed costs of integrating incremental amounts of Tehachapi wind in the CAISO control area



DR can help integrating intermittent resources; program design and technology need to evolve

- Program design: allow DR use more than in a few stress hours per year
- Automation: need fast, continuous and confirmed response to over/under forecast deviations of intermittent generation
- Visibility (telemetry): CAISO needs to know about DR's actual performance in order to adjust its short-term dispatch

PG&E is investigating Smart Grid opportunities for renewable integration

- PG&E has proposed pilots to explore DR potential for renewable integration
  - Thermal mass storage: pre-cool commercial buildings, shift afternoon cooling loads to the previous evening or early morning
  - Plug in Hybrid Electric Vehicles (PHEV): regulate PHEV charging (acting as distributed energy storage) to absorb exceeds wind and potentially provide ramp-up/down, and load following
  - Integrating more energy storage into the grid:
    - Pumped storage
    - Compressed air energy storage
    - Distribution-level storage